SYSTEM, METHOD, AND COMPUTER-READABLE MEDIUM FOR ENABLING BOTH HEARING AND HEARING-IMPAIRED CALLERS TO ACCESS A RESOURCE

5   **Cross-Reference to Related Applications**

This patent application claims the benefit of the filing date of United States provisional application serial number 60/472,256, filed on May 21, 2003, and entitled "SYSTEMS, METHODS, AND COMPUTER-READABLE MEDIUM FOR SERVING BOTH HEARING AND HEARING-IMPAIRED CALLERS USING A SINGLE

10   TELEPHONE NUMBER" and the entire contents thereof are incorporated herein by this reference as if reproduced verbatim.

Brief Descriptions of the Drawings

Figure 1 is a high level block diagram illustrating the overall function of a system **100** provided according to an illustrative but not limiting embodiment of the invention as

15   discussed herein.

Figure 2 is a high level flowchart **200** of a process flow performed by the system **100** shown in Figure 1.

Figure 3 is a flowchart illustrating various aspects of processing performed during the prompt issuing block **210** shown in Figure 2.

20   Figure 4 is a flowchart illustrating various aspects of processing performed during the response analysis block **220** and the call routing block **225** shown in Figure 2.

Figure 5 is a block diagram **500** illustrating in more detail various components that can be used to implement the invention as described herein.

Detailed Description of Illustrative Embodiments

25   As shown in Figure 1, a block diagram illustrating the overall function performed by an illustrative but non-limiting embodiment of a system **100** as described herein, a "hearing" caller **102** and a "hearing-impaired" caller **104** may call or otherwise contact an automated system **110** using the same designated or given phone number to provide or submit information, such as their respective home phone numbers **106** and **108**, to be

30   listed in a data store **112**, such as a nationwide do-not-call list. The given phone number may be communicated to the callers **102** and **104** through any number of methods,

including advertisements, public service announcements, or other notices taking any suitable tangible or intangible form or transmitted or delivered using any medium known to those skilled in the art.

The term "hearing caller" **102** is used herein to designate a "hearing" caller **102**

5   who has natural hearing capabilities sufficient to enable that caller **102** to communicate using his/her voice over the public switched telephone network (PSTN) without unreasonable difficulty, or who uses a device, such as a hearing aid, to amplify signals from the PSTN sufficiently to enable the caller **102** to communicate directly using voice over the PSTN.

10   The term "hearing-impaired" caller **104** is used to refer to a caller who has a hearing impediment sufficient to hinder his or her ability to communicate using his/her voice over the PSTN, and who may need the assistance of mechanical, electronic, acoustic, or other types of devices to use the PSTN, typically but not necessarily, using signals other than the caller's voice. Those skilled in the art will understand that these

15   two terms are not used in a strict medical sense, but instead that these terms are to be interpreted as defined herein. For example, the hearing-impaired caller **104** need not be "clinically deaf" as that term is defined in the medical field, but instead may need the assistance of a device, such as a Telecommunications Device for the Deaf/Tele-Typewriter (TDD/TTY) device, to communicate over the PSTN using a signal other than

20   his/her own voice. Preferably, the automated system **110** automatically determines, using the teachings herein, whether a given call to the given or designated telephone number originates from a hearing caller **102** or a hearing-impaired caller **104**. The latter may be calling using a TDD/TTY or other assisting device, and the system **110** processes the call accordingly.

25   As further definitional matters, the term "given phone number" refers to a single shared phone number enabling all potential callers, whether hearing callers **102** or hearing-impaired callers **104**, to dial the same telephone number to obtain the services provided by or associated with the automated system **110** or the data store **112**. The term "data store" **112** refers to a database or other data structure that can be constructed using

30   known software and hardware readily available from a variety of database software and server vendors. Data store **112** can be realized using either relational or object-oriented

database technologies. One non-limiting example of this data store **112** is a do-not-call (DNC) list, which (as an illustrative but non-limiting example) can list persons who do not wish to be contacted during outbound telemarketing campaigns. Such DNC lists can be maintained by private entities (trade or industry groups such as the Direct Marketing

5   Association, or individual telemarketing or teleservices firms), or can be sanctioned and/or maintained by governmental entities (national, state, regional, provincial or local).

In the specific context of implementing the data store **112** as a nationwide DNC list, governmental regulations may require that the automated system **110** involved in the implementation of such DNC list be accessible to both hearing callers **102** and hearing-

10   impaired callers **104** via a single given telephone number, rather providing a first phone number by which hearing callers **102** access the automated system **110** and providing a separate, second telephone number by which hearing-impaired callers **104** access the automated system **110**. This second phone number would be supported by specific equipment enabling the hearing-impaired caller **104** to communicate using whatever

15   specialized assisting devices may be necessary to allow the hearing-impaired caller **104** to communicate over the PSTN.

While the various drawing figures illustrate uni-directional data flows, those skilled in the art will recognize that these flows are shown only for the purposes of convenience, clarity, and conciseness in illustrating the flow of certain data or processing.

20   Moreover, those skilled in the art will recognize that the drawings and discussion herein do not foreclose or exclude other types of data flows, for example bi-directional data flows or flows of data content other than those shown in the drawings.

Figure 2 is a flow chart **200** illustrating an overall process flow performed by the system **100** shown in Figure 1. The process flow begins at block **205**, where the

25   incoming call is received, typically (but not necessarily) over the PSTN. More generally, any communications network, or any component thereof, capable of transmitting voice may be suitable for practicing the invention as described herein. Non-limiting examples might include technologies such as Voice Over IP, ISDN, DSL, Broadband, or any other networking or communications technology, in addition to the PSTN. Other suitable

30   technologies could include components that perform speech recognition, text-to-speech conversion, global, regional, or local computer networking, video-based communication,

or the like. This incoming call originates from either a hearing caller **102** or a hearing-impaired caller **104**, both of whom may dial a single telephone number supported by the automated system **110** as shown in Figure 1. At block **210**, the system **100** issues one or more respective prompts so as to elicit a response from either a hearing caller **102** or a

5   hearing-impaired caller **104** (or from a device used by the hearing-impaired caller **104**, such as a TTD/TTY device). The specific prompt or prompts are discussed below in further detail in connection with Figure 3.

At block **220**, the system **100** analyzes a response, if any, to the prompts issued in block **210**, which response may come from a hearing caller **102** or a hearing-impaired

10   caller **104** (or a device used by such caller **104**). The focus of block **220** is to identify what type of caller is contacting the system **110** based on the response received, so as to process and respond to the call using the appropriate platform. At block **225**, the system routes and processes the call according to the type of response received. In other words, the type of response received from either a hearing caller **102** or a hearing-impaired caller

15   **104** (who may be using some assisting device) will determine the routing and processing of the given call. The processing performed in blocks **220** and **225** are illustrated below and discussed in more detail in connection with Figure 4. After concluding processing of a given call, the process flow **200** loops back to block **205** to await the next incoming call.

20   Figure 3 is a flowchart illustrating various aspects of the processing performed in block **210** shown in Figure 2. Process flow enters from block **205** shown in Figure 2. At block **302**, the system **100** issues a prompt in a first format designed or tailored to identify a hearing-impaired caller **104** by triggering a response from a device (such as a TDD/TTY device) used by or associated with that hearing-impaired caller **104**, such as

25   known TDD/TTY devices. One non-limiting embodiment illustrative of the instant invention can include transmitting a tone(s) or specially-defined signal(s) chosen to generate or trigger a response from such a device. An illustrative but non-limiting example the context of TDD/TTY devices can include transmitting a tone or tones corresponding to the text "hello" as formulated according to the known Baudot protocol,

30   which is discussed in more detail below. As known in the art of TDD/TTY devices, such devices do not continuously emit signals as do conventional modems. Instead, such

TDD/TYY devices only transmit signals when the user types characters, or can transmit signals periodically if so configured. For example, certain TDD/TTY devices may be configured to transmit signals representing the text "Hello" at a pre-defined interval. When the invention is practiced with such devices, it may not be necessary to issue the

5   prompt represented by block 302. Accordingly, the prompt issued by the system 100 as represented in block 302 is intended to generate or trigger this response from the TDD/TTY device, which response would thereby indicate to the system 100 that a hearing-impaired caller 104 using such a device is on the line.

          Turning to block 304, the system 100 issues at least a second prompt in a second

10   format designed or tailored to identify a hearing caller 102 by causing that caller 102 to respond in some way to the prompt issued in block 304. In illustrative but non-limiting embodiments of the invention, the prompt represented in block 304 may comprise a speech or verbal prompt intended to generate a specific response from the hearing caller 102. An illustrative but non-limiting example might be a verbal pre-recorded prompt

15   directing the caller 102 to "press 1 if calling from a touchtone phone". However, other prompts may be equally suitable and can be constructed by those skilled in the art without departing from the scope of the invention as described herein. If the caller responds as requested to the speech/voice prompt, for example by pressing a keypad to generate an expected or requested tone(s) or signal(s), the caller is most likely a hearing

20   caller 102. Prompting the caller to generate one or more dual-tone multi-frequency (DTMF) tones is one non-limiting example of identifying a hearing caller 102.

          Strictly for convenience in illustrating and discussing the processing shown in Figure 3, the respective blocks 302 and 304 are shown as proceeding in parallel. However, those skilled in the art will understand that the configuration shown in Figure 3

25   is non-limiting, and that the processing performed by the respective blocks 302 and 304 could proceed in series, or in any other fashion or arrangement apparent to those skilled in the art. Those skilled in the art will further understand that the issuance of the respective prompts shown in blocks 302 and 304 may be synchronized with one another, may be completely asynchronous with one another, or further that the prompts may be

30   issued in any chronological relationship to one another. For example, the prompt corresponding to block 302 might be issued first and the prompt corresponding to block

304 might be issued only if no response is received after a given period of time, and vice versa. Also, both prompts could be issued at approximately the same time, or simultaneously with one another. In still further examples, a first prompt in a first format (either voice prompt or TDD/TTY message) could be issued, and if no response has been

5   received after a predefined time period, the other prompt could be issued in the other format (either TDD/TTY or voice prompt, whichever was not issued before). If neither prompt generates a response, the call will most likely be terminated due to an unresponsive caller.

          Figure 4 illustrates various aspects related to analyzing and processing different

10   types of calls from respective callers **102** or **104** and expands further on the processing represented by blocks **220** and **225** shown in Figure 2, as represented by the dashed outlines shown in Figure 4. Processing enters from block **210** in Figure 2 and begins at decision block **402**, which determines whether any response to the prompts issued in block **210** of Figure 2 has been received from the caller, who may be a hearing caller **102**

15   or a hearing-impaired caller **104**. If no response whatsoever has been received (from either a hearing caller **102** or a hearing-impaired caller **104**, or a device associated therewith), then the process proceeds to block **408**, which indicates an unresponsive caller **102** or **104**. Under these circumstances, the process cannot operate further, and the call is considered terminated. The process would then branch back to block **205** in Figure

20   2 to await the next call.

          If a response of some sort is received from the caller **102** or **104** (or a device associated therewith), the method proceeds to decision block **404**, which determines whether a tone(s) or signal(s) having a frequency of approximately 1400 or 1800 Hz has been received in response to the prompts issued in block **210** as shown in Figures 2 or 3

25   (more particularly block **302**) in Figure 3. Under the known Baudot protocol, a logical "1" (or "mark") is indicated by a 1400-hertz tone, while a logical "0" (or "space") is indicated by an 1800-hertz tone. As known in the art, Baudot-compatible devices communicate at 45.5 baud and utilize a 5-bit code used only by Baudot-compatible devices. The term "approximately" is used herein to indicate that the frequency of the

30   tone(s) or signal(s) received or transmitted by the automated system **110** need not be exactly 1400 or 1800 Hz, but instead may vary from these frequencies due to distortion,

equipment or software limitations, noise affecting transmission media, or other environmental conditions affecting a given implementation of the invention. Thus, the frequencies of the signals corresponding to logical "1" or logical "0" may vary from the frequencies specified by the Baudot protocol without departing the scope of the

5   invention.

Those skilled in the art will further recognize that the recognition of the approximately 1400 hertz or 1800 hertz signal(s) in block **404**, and the issuance of a prompt to trigger such signals in block **210** of Figure 2 and in block **302** in Figure 3, provide illustrative rather than limiting embodiments of the invention, specific to an

10   example implemented based on Baudot communication. Those skilled in the art will further recognize that if other communication protocols are appropriate for a given application of the invention, or if the Baudot protocol is modified or supplanted in favor of another communications protocol suitable or appropriate for the hearing-impaired, the nature and characteristics (such as frequency) of the tones or signals handled in blocks

15   **404** and **410** may vary from those illustrated respectively in Figures 2 and 4 and discussed herein, while still remaining within the scope of the invention. Likewise, the signal(s) or tone(s) representing the prompts issued in blocks **210** (Figure 2) and **302** (Figure 3) may vary as well under such circumstances.

Those skilled in the art will further recognize that the components implementing

20   decision block **404** could be configured to recognize either a specific, discrete tone or signal or a sequence of tones or signals as indicating the presence of a hearing-impaired caller **104** who may be using an assisting device. Further, the nature and content of these recognized tone(s) signal(s) may vary in response to the types of devices or technology known and used by hearing-impaired callers **104** to access the PSTN or other

25   communication networks.

At decision block **404**, if an approximately 1400 hertz tone(s) or a 1800 hertz tone (or other suitable discriminating signal) has been received, then most likely the caller contacting the system **100** is a hearing-impaired caller **104** who is using a TDD/TTY device to communicate over the PSTN. Accordingly, the process proceeds to block **410**,

30   where the call from the hearing-impaired caller **104** is routed to a processing platform equipped to handle TTY/TDD calls.

The method then proceeds to block **412**, which represents the process of conducting a TTY/TDD-based dialog with the hearing-impaired caller **104** to execute the transaction sought by the caller **104**, such as storing caller-specific information in the data store **112**. This dialog may be, but need not necessarily be, conducted using a

5   specifically defined grammar. While conducting this dialog with the hearing-impaired caller **104**, for example to enter the home number **108** of the hearing-impaired caller **104** into the data store **112** in the form of a DNC list, it may be necessary to limit, via the grammar, the possible responses from the hearing-impaired caller **104** that will be recognized and processed. In short, it may be necessary to define this grammar to realize

10   a closed-ended dialog truncated as appropriate to conduct the transaction sought by the hearing-impaired caller **104**, rather than an open-ended, conversational-type dialog. Curtailing the dialog in this manner makes it possible to automate the entire transaction between the hearing-impaired caller **104** and the automated system **110**, thereby eliminating the labor expense and complexity of a telecommunications relay service

15   (TRS) or an operator services for the deaf (OSD) facility. Also, the grammar could be tailored as appropriate given that the caller **104** is hearing-impaired and that the Baudot protocol is a relatively low-bandwidth protocol by contemporary standards. Thus, the interaction supported by this grammar may or may not consist of merely sending Baudot code representations of existing voice prompts. Specifically, the prompts may be

20   shortened to take advantage of known Baudot conventions, or otherwise modified to facilitate efficient interaction with the hearing-impaired caller **104**. Continuing the non-limiting DNC list example discussed above, block **412** obtains the home number **108** of the hearing-impaired caller **104** and enters it into the data store **112**.

Returning to decision block **404**, if neither a 1400-hertz tone nor an 1800-hertz

25   tone (nor any other type of discriminating signal or signals) is received, processing proceeds to decision block **406**. Block **406** determines whether a tone or signal, such as a DTMF tone, as requested, or approximately or substantially as requested by the speech prompt issued in block **304** (Figure 3) was received. If so, the process proceeds to block **414**, where the method determines that the caller is most likely a hearing caller **102** who

30   has responded as requested to the prompt issued in block **304**, and further that this call should be processed using a platform such as a DTMF-based platform. In other alternate

embodiments, the prompt could ask for voice or speech input from the caller **102**, rather than DTMF input. For example, the prompt could request that the caller say "Proceed" or some other command, which in turn could be analyzed using a speech-recognition engine. If the caller **102** responds to the prompt (whether by DTMF, voice, or

5   otherwise), the method concludes that the call should be processed using a platform that can support hearing callers **102**, such as a DTMF-based platform or a speech-enabled platform.

Those skilled in the art will recognize that the nature and content of DTMF signals are well known and established. The terms "substantially" and "approximately"

10   are used here with the same meaning as discussed above in the context of processing TTD/TTY signals.

Continuing with the DNC list example above, the method functions to obtain the home phone number **106** of the hearing caller **102**, and to store it in the data store **112**. The DTMF-based platform can be configured to obtain this information using known

15   technology to conduct a dialog with the hearing caller **102**. This dialog could proceed by having the system prompt the hearing caller **102** via speech/voice prompts, with the hearing caller **102** responding with DTMF keystrokes or speech/voice as necessary to conduct whatever transactions are sought by the hearing caller **102**. However, this scenario is illustrative in nature, and is not intended to limit the scope of the invention.

20   Returning to decision block **406**, if a response other than DTMF or touchtone signals or tones responsive to the prompt issued in block **304** is received, the method proceeds to block **416**. Non-limiting examples of the types of responses that would cause the flow to reach block **416** can include an incorrect DTMF key-in, the caller speaking instead of keying-in DTMF digit(s) as requested, incorrect voice responses, or the like.

25   Block **416** corresponds to a caller, most likely a hearing caller **102**, who may be calling from a rotary or non-touchtone telephone handset, or may be an inattentive but hearing caller **102** who is using a DTMF or touchtone handset and provides the wrong DTMF or voice input in response to the prompt issued in block **304** (Figure 3). In this situation, the method functions to conduct a speech-based dialog with the caller **102**, and processes

30   responses from the hearing caller **102** using known speech-recognition technology. In block **416**, the hearing caller **102** responds via voice, while in block **414**, the hearing

caller **102** responds via DTMF keystrokes. Alternatively, if the hearing caller **102** keyed-in the wrong DTMF tone, the method could re-prompt the hearing caller **102** to enter the required DTMF tone, and continue to block **414**. As still another alternative, if the hearing caller **102** responds with the incorrect DTMF tone, the method can conclude

5   nevertheless that the hearing caller **102** is using a touchtone phone and route the call to the DTMF platform to attempt the speech-based dialog discussion above. The latter two alternatives are symbolized in Figure 4 by the dashed line **418**.

Speech recognition technology suitable for implementing block **416** is readily available from a variety of vendors, including but not limited to Nuance Corporation of

10   Menlo Park, California (www.nuance.com). In the DNC list example discussed above, the method functions to obtain the caller's home phone number **106** and store it in the data store **112** in the form of the DNC list.

Those skilled in the art will recognize that various embodiments of the invention can include varying the relative order of decision blocks **402, 404,** and **406** from that

15   shown in the illustrative but non-limiting embodiment of Figure 4. Specifically, the ordering of blocks **402, 404,** and **406** could be varied, such that the method tests first for the correct DTMF response from hearing caller **102** using a touchtone phone, then for the tones/signals associated with a device (such as a TDD/TTY device) used by a hearing-impaired caller **104**. Also, these decision blocks could be conducted in parallel. The key

20   activity represented in Figure 4 is the routing of calls to the appropriate platform for processing based on responses to the prompts discussed above. Various forms of decision logic that realize this goal may be appropriate in different implementations or applications of the teachings herein.

Figure 5 is a block diagram **500** illustrating various components suitable for

25   implementing the invention as described herein. A hearing caller **102** and a hearing-impaired caller **104** initiate respective calls **502** and **504** using a single phone number, which is serviced by an automated system **110** comprising at least in part computer-based sub-systems and/or telecommunications equipment such as a voice response unit (VRU) **505**. VRUs are also referred to in the industry as interactive voice response (IVR) units.

30   The automated system **110**, more particularly the voice response unit **505**, can be configured to perform the functions discussed above to route incoming calls **502** and **504**

to the appropriate platform **508, 512, 512a,** or **516** for processing, using, for example, the logic shown and discussed above in connection with Figure 4. Calls **506** placed by a hearing caller **102** using a DTMF/touchtone handset are routed to the DTMF platform **508**, which may be implemented as a separate standalone component, or integrated into

5   the VRU/IVR **505**.

The VRU **505** can also be configured to identify calls **514** placed by the hearing caller **102** using rotary telephone equipment, or hearing callers **102** who fail to respond as requested to enter appropriate DTMF/touchtone signals into a touchtone keypad handset. Also, callers **102** may issue speech or voice commands in response to prompts, which

10   speech or voice commands result in such callers being routed to speech recognition platform **516**. These calls are ultimately handled on a speech recognition platform **516** implemented using suitable speech recognition technology as discussed above. As with DTMF platform **508**, the speech recognition platform **516** may be implemented as a separate, standalone component, or integrated into the VRU/IVR **505**.

15   The VRU **505** is also configured to identify calls **504** from hearing-impaired callers **104** for processing using a dedicated TTY/TDD processing platform **512**. As an alternative, such calls **504** can be routed to a conventional TRS/OSD facility **512a**. Thus the method and system of the various aspects of the invention as described herein can identify and divide incoming calls from callers **102** and/or **104** into three broad classes

20   represented by the arrows **506, 510,** and **514** for handling by the respective platforms **508, 512, 512a,** and **516**. In the non-limiting DNC list example discussed above, these respective platforms **508, 512, 512a,** or **516** obtain the relevant telephone numbers **106** and **108** for storage in the data store **112** in the form of the DNC list.

Methods and systems provided according to the teachings herein may enable

25   construction and use of an automated system that provides a pre-defined, single telephone number to enable both hearing callers **102** and hearing-impaired callers **104** to provide pertinent information to be stored in data store **112** in the form of a DNC list, rather than establishing two separate phone numbers for hearing callers **102** and hearing-impaired callers **104**, respectively, and supporting each of these phone numbers with appropriate

30   equipment based on the types of calls received at that number. In contrast with other systems that effectively impose the routing function upon the callers themselves, the

invention as disclosed herein preferably performs this routing automatically, making the data store **112** accessible to all callers **102** and **104** using the single telephone number, thereby complying with governmental regulations that may be applicable to the construction and maintenance of a nationwide DNC list.

5   Those skilled in the art will appreciate that while the drawing figures and this description discuss listing of phone numbers in the data store **112** in the form of a DNC list, the concepts discussed herein may be equally applicable to perform other functions. Generalizing beyond the DNC list, the invention herein may be deployed to enable both hearing and hearing-impaired callers **102** and/or **104** to access or utilize some resource of

10   which the data store **112** in the form of the DNC list is but one illustrative example. More particularly, the invention as disclosed herein may be applied in the above context to enable the callers **102** and **104** to access or otherwise utilize the resource (such as the DNC list).

          As used herein, the term "platform" refers to any hardware and/or software used

15   to support the transactions described herein with the callers **102** or **104**. These platforms may be customized or configured to realize the functions discussed herein. Further, these platforms can reside on either the VRU or as separate, stand-alone components or modules in communication with the VRU or other computer-based sub-system.

          Other illustrative embodiments of the invention can include building a look-up

20   table for various callers **102** and/or **104**, indexing it by the caller's telephone number (as provided by Automatic Number Identification (ANI) technology or other means) after a first contact with a given caller, storing data in the table indicating whether the caller associated with the telephone number is hearing or hearing-impaired, and then referring to this table entry during a second or further contact with the given caller. This second

25   contact can then be routed to the appropriate platform based on this table look-up. Those skilled in the art will recognize that this look-up table could be compiled based only upon the first interaction between the caller and the automated system **110**, or based upon other interactions between the callers **102** or **104** and other systems or entities. In other illustrative embodiments, whether the caller is a hearing caller **102** or a hearing-impaired

30   caller **104** can be inferred based on past transactions conducted by the caller, for example transactions conducted with entities other than the automated system **110**. For an

example of suitable technology for analyzing past transactions and drawing conclusions therefrom, see U.S. Patent 6,055,513, the contents of which are incorporated herein by this reference as if reproduced verbatim.

5　A suitable application program can implement software residing on the computer-readable medium or media **230** (Figures 2 and 4) and embodying the various aspects of the method discussed herein and shown in the drawing figures, and can be coded using any suitable programming or scripting language. However, it is to be understood that the invention as described herein is not dependent on any particular operating system, environment, or programming language. Illustrative operating systems include without 10　limitation LINUX, UNIX, or any of the Windows™-family of operating systems, and illustrative languages include without limitation a variety of structured and object-oriented languages such as C, C++, Visual Basic, or the like.

As those skilled in the art will understand, the program of instructions can be loaded and stored onto a program storage medium or device **230** readable by a computer 15　or other machine, embodying a program of instructions executable by the machine to perform the various aspects of the invention as discussed and claimed herein, and as illustrated in the drawing figures. Generally speaking, the program storage medium **230** can be implemented using any technology based upon materials having specific magnetic, optical, semiconductor or other properties that render them suitable for storing 20　computer-readable data, whether such technology involves either volatile or non-volatile storage media. Specific examples of such media can include, but are not limited to, magnetic hard or floppy disks drives, optical drives or CD-ROMs, and any memory technology based on semiconductors or other materials, whether implemented as read-only or random access memory. In short, this embodiment of the invention may reside 25　either on a medium directly addressable by the computer's processor (main memory, however implemented) or on a medium indirectly accessible to the processor (secondary storage media such as hard disk drives, tape drives, CD-ROM drives, floppy drives, or the like). Consistent with the above teaching, program storage device **230** can be affixed permanently or removably to a bay, socket, connector, or other hardware provided by the 30　cabinet, motherboard, or other component of a given computer system.

Those skilled in the art will also understand that a computer programmed in accordance with the above teaching using known programming languages provides suitable means for realizing the various functions, methods, and processes as described and claimed herein and as illustrated in the drawing figure attached hereto.

5   Various embodiments of the invention are described above to facilitate a thorough understanding of various aspects of the invention. However, these embodiments are to be understood as illustrative rather than limiting in nature, and those skilled in the art will recognize that various modifications or extensions of these embodiments will fall within the scope of the invention, which is defined by the appended claims.

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